WATER QUALITY ASSESSMENT OF CHEPOR RIVER AND PINJI RIVER USING MACROINVERTEBRATE AS BIOINDICATOR

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ABSTRACT

Water quality studies using macroinvertebrates as bioindicator was conducted at Chepor River and Pinji River located in the state of Perak. Biological Water Quality Index was used to assess the river quality and it is then compared Water Quality Index (WQI) results obtained from Department of Irrigation and Drainage. The water quality parameters studied are dissolved oxygen (DO), Biological Oxygen Demand (BOD), Chemical Oxygen Demand (COD), pH, Total Suspended Solids (TSS) and Ammonical Nitrogen (AN). The BWQI calculated in the rivers are in the range of 3.33 to 6.87 whereas the WQI for the parameters studied at the rivers are in Class II to Class III. There are several groups of macroinvertebrates commonly found in the river i.e. flattened mayfly nymphs, dobsonfly larvae, adult beetles, river prawns, freshwater shrimps, Square-gilled mayfly, non-biting midge larvae, greater eater boatmen, and swan mussels.

Keywords: Macroinvertebrate, biological indicator, Biological Water Quality Index, Water Quality Index.

1.0 Introduction

Water quality assessment using macroinvertebrates is a simplest method to estimate water quality where the whole habitat and biology diversity aquatic environment is closely related. Study on invertebrates can help us to identify water quality because every type of animals needs certain and suitable environment for their live hood (Hynes *et.al* 1970). Macroinvertebrate does not possess backbone and is visibly viewed with unaided eye. There are four major macroinvertebrate groups commonly found in rivers i.e. insect, crustacean, mollusk and worm including fluke, segmented worm and leech. Insect is the most dominant macroinvertebrate group in fresh water habitat. Most insects still depends on land habitat for lifecycle (Department of Irrigation and Drainage). Most macroinvertebrate in water especially in rivers can indicate the cleanliness level or level of water pollution in the river. This macroinvertebrate is called "pollution indicator" and most of this macroinvertebrate are available in rivers and lakes. Groups of macroinvertebrate life can be divided based on the pollution level from very clean to polluted river water.

1.1 Problem Statement

The process of urbanization and rapid industrialization in a country can produce various types of effluent and sewage into the natural water system and this causes water pollution incident. Deterioration of water quality is usually caused by several factors such as waste from domestic sewage, industrial, and agricultural animals. These changes have resulted in the river is no longer able to function in biological and ecological value decreased. Therefore, this change began to produce stress such as increased nutrients, increased saline, pesticides, sediment load, water intake, water flow control and discharges of effluents.

1.2 Objectives of Study

The following are the objectives of this study:

a) To identify the presence of macroinvertebrate in Chepor River and Pinji River.
b) To analyze river conditions using macroinvertebrate based on Biological Water Quality Index (BWQI).
c) To determine and compare the effectiveness of using BWQI as an alternative method to WQI.

1.3 Scope of Study

The scope of this study is focused on:

a) Two rivers was selected for this study which differs in pollution state. The rivers are Chepor River and Pinji River.
b) The calculation of BWQI was based on the key guidelines by Department of Irrigation and Drainage, Malaysia.
c) Classification on the rivers studied was made based on WQI and the water quality parameters studied are Dissolved Oxygen, Biological Oxygen Demand, Chemical Oxygen Demand, pH, Total Suspended Solids and Ammonical Nitrogen.

2.0 Methodology

2.1 Study area

The study was conducted at Chepor River and Pinji River. Table 1 shows the coordinate of the sampling stations.

Table 1: Coordinate of the sampling stations.

Location	Station	Coordinate
Chepor River	SC1	4°39' 46.1" N 101° 05' 44.6" E
	SC2	4° 39' 50.4" N 101° 05' 48.5" E
	SC3	4° 39' 55.2" N 10°1 05' 52.4" E
Pinji River	SP1	4° 30' 07.7" N 101° 03' 24.8" E
	SP2	4° 30' 10.2" N 101° 03' 28.1" E
	SP3	4° 30' 13.4" N 101° 03' 32.3" E

2.2 Macroinvertebrate Sampling and Analysis

This method is a biological method used to determine river water pollution. It is a simple method where it can be conducted by all ages and education level. This method does not require expensive and sophisticated tools and it does not involve the use of any chemical substance. The tools needed are:

1. Insect net used to sample macroinvertebrate
2. Plastic Container/plate - used to transfer content from insect netting
3. Universal bottle – required for insect identification.
4. Forceps and pipette
5. Spoon – used to scoop up macroinvertebrate quickly
6. Magnifying glass – to identifying macroinvertebrate species.

2.3 Procedure

1. Fill in a small amount of river water on a plate.
2. Use the net to scoop around and search for macroinvertebrates.
3. Pour samples collected using netting on a plate that is filled with river water.
4. Note roughly to see whether there is any movement of life on the plate.
5. If there is macroinvertebrate life movement on the plate, use forceps to pick it up and placed it into the universal bottle.
6. Identify the macroinvertebrates in plate using magnifying glass.
7. Repeat step 1 to 6 until at least 4 invertebrate species have been identified.
8. Calculate total score based on 'Biological Quality Index' to determine river water quality.

2.4 BWQI Score

BWQI Score for macroinvertebrates is able to predict water quality of its habitat and whether it is tolerant or non-tolerant to polluted areas. The score in the table will only work in streams and rivers with running water. These scores do not measure pollution from chemicals such as mercury or some pesticides. In clean water it is likely to find many kinds of animals, but only a few exists in polluted water. The sources are calculated based on identifying the macroinvertebrate category and marking the score in the box. After that calculate all the scores and then take the average by dividing the total score with the number of macroinvertebrate's types. It is important to calculate an average score as this will reduce any recorded error that was made during sampling. Table 2 shows the Biological Water Quality to assess the water quality.

Table 2: Biological Water Quality Index (Department of Irrigation and Drainage)

Score	Water Quality
7.6-10	Very clean water
5.1-7.5	Clean water
2.6-5.0	Average
1.0-2.5	Dirty water
0-0.9	Very dirty water

3.0 Result and Discussion

Table 3 shows the BWQI calculated for Chepor River and Pinji River. BWQI calculated for Chepor River is 6.87 which show that the river is clean. The is due to the fact that the river is a scheduled recreational spot. The river were surrounded with forest, rocks and shady. Five species of macroinvertebrate were recorded at Chepor River i.e flattened mayfly nymphs, dobsonfly larvae, adult beetles, and river prawns and freshwater shrimps. Flattened mayfly nymph's need good quality water with lots of oxygen. Found mainly in fast flowing streams they may do pushups to increase water flow if oxygen supply gets a bit low, and soon disappear with pollution. When these animals go missing, this is a sign that water quality is changing. Meanwhile Dobsonfly larvae are also quite sensitive to pollution. The presence of this group of macroinvertebrate shows the DO concentration are high. A good river contains high dissolved oxygen from 7.1 mg/l to 8.73 mg/l (Barbour *et al.* 1996). BWQI calculated for Pinji River is 3.33 showing the river is classified as slightly polluted. The condition is due to rural housing area, cow's farm and car workshop which can increases ammoniacal nitrogen. Macroinvertebrates found are square-gilled mayfly, non-biting midge

larvae, greater eater boatmen and swan mussels. Square-gilled mayflies are particularly tolerant to pollution and they can live in a low DO concentration. Therefore they are found mainly in slow flowing streams. Non-biting midge larvae also is a group that can tolerant to pollution and live in warmer places, optimum pH and low DO concentration.

Table 3: BWQI for Chepor River and Pinji River.

River	BWQI	Macroinvertebrates	Status
Chepor River	6.87	Flattened mayfly nymphs, dobsonfly larvae, adult beetles, river prawns and freshwater shrimps	Clean
Pinji River	3.33	Square-gilled mayfly, non-biting midge larvae, greater eater boatmen, swan mussels.	Slightly Polluted

Table 4 shows the results obtained for water quality parameters. From the result, Chepor River has the highest concentration of dissolved oxygen at 7.39 mg/L and is classified in Class II. The lowest DO concentration was recorded at Pinji River at 5.09 mg/L and is classified in Class III. From the result obtained the pH at Pinji River is the lowest at 5.59 while the highest pH value was 7.58 at Chepor River. The lowest concentration of ammoniacal nitrogen (AN) was 0.53 mg/L and was recorded at Chepor River while the highest concentration was 1.38 mg/L at Pinji River. From the analysis, it was found that WQI Chepor River is in Class II and the results showed BWQI for Chepor River is clean. Meanwhile for Pinji River, WQI is in Class III and BWQI slightly polluted.

Table 4: The result obtain from river water monitoring in Perak.

River	DO (mg/L)	TSS (mg/L)	BOD (mg/L)	COD (mg/L)	pH	AN (mg/L)	WQI
Chepor River	7.39	3.50	3.0	15	7.58	0.53	81.6 – Class II
Pinji River	5.09	22	3.0	18	5.59	1.38	73.6 – Class III

4.0 Conclusion

Results shows that the Chepor River and Pinji River are in class of average or slightly polluted. Result for BWQI and WQI are at par. Water quality analysis based on collection and identification of macroinvertebrates is a relatively cheap method compared to other water quality methods and is easily applied by individuals from different age and education level. Furthermore the results and classification of rivers is obtained in a short time frame usually below two hours compared to chemical analysis. It does not need any chemical and is easily conducted. The tools used in collecting the macroinvertebrates sample are also easily available and cheap. Therefore BWQI is a relatively easy method to be conducted and should serve as a way of monitoring rivers.

5.0 References

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